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A SYSTEM FOR DOSED FEEDING OF BATCH AND CULLET INTO A GLASS-MELTING FURNACE

V. V. Efremenkov,[1] K. Yu. Subbotin,[1] and M. M. Khaimovich[1]

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Possible variants of dosed batch and cullet feeding into a glass-melting furnace are described. The specifics of using discrete and continuous strain-gauge cullet weighing machines produced by Stromizmeteritel' JSC are considered.

Glass cullet has a significant role in intensifying the glass-melting process and decreasing the production cost of glass articles. Partial replacement of a glass batch with cullet accelerates the melting process, reduces the specific consumption of fuel, decreases dust emissions to the atmosphere, and contributes to saving scarce alkaline-bearing materials and extending the service life of the glass-melting furnace. Traditionally, the cullet content in the batch is 10 – 30%, and it varies depending on the purpose of the glass and the type of product. For instance, the quantity of cullet used in making bottles of brown and green glass can reach 45 and 80%, respectively.

There are several known variants of dosed feeding of batch and cullet into a glass-melting furnace [1].

The most common one is alternate charging of batch and cullet into batch-charging hoppers, employing buggies or buckets. In this case, the batch and cullet arrive at the furnace in non-uniform layers, and their prescribed ratio is maintained through volumetric batching, whose accuracy to a great extent depends on the varying bulk density of the cullet.

A more uniform feeding of batch and cullet to the glass-melting furnace can be accomplished by charging the glass batch on top of the cullet layer, using rotary chargers, or by conveyor feeding, when the batch and cullet layers on the belt are obtained by setting prescribed output levels to the batch and cullet feeders. Yet even in these variants the batch : cullet ratio, because of the absence of the weight control, is maintained with random errors and substantial deviations in the consumption of the measured materials.

In the cases of volumetric dosing or rotary charger dosing, the fluctuations in the bulk density of the raw materials charged into the glass-melting furnace result in alterations in the weight consumption of batch and cullet, which, in turn, disturbs their melting temperature regime and modifies the position of the melting foam boundary along the melting tank.

Therefore, to stabilize the melting process, it is necessary to ensure a precise weight batch : cullet ratio.

A cullet-dosing set (KDSB) and a continuous proportional weigher (DNP-20K) produced by Stromizmeritel' JSC are intended for weight dosing and maintain the ratio of batch and cullet prescribed by the formula.

KDSB is a batch-type strain-gauge discrete scale with vibration charge and discharge feeders and can be used both on a mixing and weighing line, when cullet is charged into a mixer, and on a conveyer line transporting batch and cullet to the melting tank.

Blending of cullet and batch in a mixer makes it possible to obtain a homogeneous mixture but increases the content of hardware iron in the batch, owing to the high abrasive properties of cullet, which leads to fast wear of the agitator blades, even when the cullet is crushed to a lump size of 5 – 10 mm. Therefore, it is more advisable to implement cullet dosing using a KDSB set on a conveyor belt transporting the batch from the mixer. The weight of the cullet charge and the output of the cullet discharge feeder are coordinated with the weight and the transport time of the batch portion discharged from the mixer. The weighing cycle for a cullet portion of 300 – 700 kg lasts 90 – 120 sec, and the error does not exceed 0.5% of the highest dosing limit.

If the batch from the mixer arrives first at an intermediate storage hopper, the prescribed batch-to-cullet ratio can be maintained by using (depending on the equipment layout) an additional strain-gauge batch-type weigher, which functions in combination with the cullet batch-type weigher, or using

[1] Stromizmeritel' Joint-Stock Company, Russia.

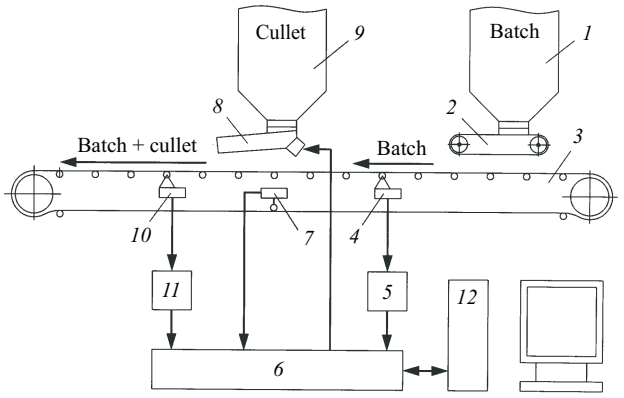

Fig. 1. System of dosed feeding of batch and cullet to a glass-melting furnace.

the system of dosed feeding of batch and cullet with the DNP-20K dosing machine.

The system of dosed feeding of batch and cullet to the glass-melting furnace based on DNP-20K weigher (Fig. 1) operates in the following way. The feeder 2 feeds the batch from the intermediate hopper *1* in a uniform flow on a moving conveyor belt *3*. In transportation, the batch flow passes above the weight-receiving unit *4*, and a signal from this unit via the strain-gauge amplifier *5* is transmitted to an analog-to-digital converter in the dosing control block *6* (DCB). At the same time, the conveyor belt movement is monitored via a sensor *7*, which generates transportation pulses. The number of pulses is proportional to the transport of the belt with the material to a certain distance. The pulses are transmitted to the DCB and used to calculate the weight of the material having passed over the weight-receiving unit.

Depending of the current consumption of batch and in accordance with the preset batch-to-cullet ratio, the dosing control block performs the computations and generates a controlling signal transmitted to the vibration feeder *8*, which discharges cullet from the hopper *9* onto the batch layer. The vibrofeeder has 15 possible operating modes. Next, the mixture of batch and cullet is transported above the weight-receiving unit *10*, which via the strain-gauge amplifier *11* transmits a signal equal to the total consumption of the dosed materials to the DCB.

All computation results from the dosing control block arrive at the computer *12*, which determines the total weight consumption of the batch and cullet since the beginning of the shift or since the latest program reset and stores it in memory for subsequent filing.

The consumption of materials having passed the weight-receiving units *4* and *10* is calculated by integrating the instantaneous current load values within the measured period between the pulses of the belt motion sensor. The computation is performed in the units of the analog-to-digital converter, in which the weight of packaging or the weight of the empty conveyor belt is subtracted from the total load value. The resulting value is divided by the calibration coefficient and converted into kilograms.

The packaging weight and the calibration coefficient of each weight-receiving unit are determined in taring and calibration and are indicated on the computer display in the weigher setting window. To avoid measurement errors related to the variability of the weight load and accidental impacts of the conveyor belt against the weight-receiving rollers, the weigher setting window on the computer display contains "Packaging tolerance" and "Maximum impact length" parameters. The setting parameters also include: batch : cullet ratio (%), conveyor belt step between two pulses of sensor *7*, 15 levels of vibrofeeder intensity, etc.

The required cullet feed intensity is calculated based on the current batch consumption, in accordance with the preset ratio and taking into account the cullet dosing error, equal to ± 2.0 – 5.0% (which is determined as the difference between the expected and the actually measured consumption of the batch and cullet mixture). This makes it possible to automatically adjust the cullet consumption based on the batch consumption. If the feed of cullet onto the conveyor belt is insufficient, the absolute value of the dosing error can exceed the "Maximum error" threshold, which may cause an emergency situation. In this case, the vibrofeeder is transferred to the maximum output operating mode.

To decrease the dosing error, the cullet content in the mixture should not be below 5%, and the load capacity of the belt should be used in the interval of 20 – 100% of the maximum theoretical loading of the weight conveyor. The technical requirements imposed on the DNP-20K weigher include the required weight zone dimensions and distances between the weight zones and the conveyer drive and take-up and certain values of the width, thickness, and slope of the belt, etc.

The use of the KDSB set and the DNP-20K weigher makes it possible to solve the problem of dosed feeding of batch and cullet to a glass-melting furnace for different variants of machinery layout. Thus, DNP-20K weighers without substantial capital investments (just by replacing standard roller supports by weight roller support) can be installed on stationary belt conveyors of transport lines, which is important in reconstruction of existing production facilities.

Such systems for dosed feeding of batch and cullet to glass-melting furnaces were implemented at the Mineralovodskii glass factory, at the Salavatsteklo Company, and at some other glass works.

REFERENCES

1. N. A. Pankova and N. Yu. Mikhailenko, *Glass Batch and the Practice of Its Preparation. A Manual* [in Russian], Moscow (1997).